Healthcare delivery systems have evolved to rely more heavily on technology in recent years. There has been a shift in care, diagnosis and treatment which has decreased the importance of traditional methods of care delivery. Technology has not only helped to extend our lifespan, but it has improved the quality of life for all citizens.

This book presents the proceedings of the 20th Annual CyberPsychology, CyberTherapy & Social Networking Conference (CYPSY20), held in San Diego, California, in June/July 2015. The conference is an international networking and sharing platform for researchers, clinicians, policymakers and funding agents to share and discuss advancements in the growing disciplines of CyberTherapy & CyberPsychology. The papers included here have been divided into six main sections: editorial; critical reviews; evaluation studies; original research; clinical observations and work in progress.

The book underlines how cybertherapy has started to make progress in treating a variety of disorders, and provides an overview of the necessary skills and tools available, as well as illuminating the context of interaction in which they operate.

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Decision Making and Cognitive Behavioral Flexibility in a OCD Sample: a Study in a Virtual Environment

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Abstract. Neuropsychological disorders are common in Obsessive-Compulsive Disorder (OCD) patients. Executive functions, verbal fluency and verbal memory, shifting attention from one aspect of stimuli to others, mental flexibility, engaging in executive planning and decision making, are the most involved cognitive domains. We focus on two aspects of neuropsychological function: decision making and cognitive behavioral flexibility, assessed through a virtual version of the Multiple Errand Test (V-MET), developed using the NeuroVR software.
Thirty OCD patients were compared with thirty matched control subjects. The results showed the presence of difficulties in OCD patients with tasks where the goal is not clear, the information is incomplete or the parameters are ill-defined.

Keywords. Obsessive-Compulsive Disorder, decision making, cognitive behavioral flexibility, Virtual Multiple Errands Test, neuropsychological assessment

Introduction

Obsessive-Compulsive Disorder (OCD) is a psychiatric disorder involving distressing intrusive thoughts and related compulsive behaviours [1]. Neuropsychological studies have also shown that patients with OCD show deficits in cognitive abilities that are strictly linked to the functioning of the frontal lobe and its related fronto-subcortical structures, such as executive functioning deficits and insufficient cognitive-behavioral flexibility [2]. Individuals with OCD have been observed to experience difficulties in shifting attention from one aspect of stimuli to others, engaging in executive planning [3]. A relevant cognitive skill linked to the executive functions is decision-making. It is a cognitive mechanism that can be related to different executive processes and involves the ability to evaluate environmental information of various options that ensures actions are taken in the light of positives and negatives of each option. The effectiveness of decision-making requires some degree of predicting outcome certainty

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of each option in relation to particular situations. Decision making appears to be dysfunctional in the OCD, in the context of doubting and uncertainty as well as in dual and sequencing tasks.

The role of uncertainty in decision-making has yet to be fully investigated systematically in OCD [4]. However, clinical decision-making performance reveals that OCD participants request more information about, and spend more time deliberating over low-risk scenarios and OCD-relevant decisions compared to non-anxious controls [5]. OCD patients seem to require more information before making a decision and excessive worry and doubt, core features of OCD, could mediate difficulties in decisions-making [5].

The present study is aimed to explore and assess the decision-making and the mental and behavioral flexibility in OCD patients trough complex tasks of virtual version (VR) of the Multiple Errands Test (MET) [6, 7, 8] developed based on the NeuroVR software. The virtual environment is a supermarket, performed in a shopping setting and involves the completion of various tasks of different complexity levels (e.g. buy a sponge or two products from the refrigerated products aisle as going to the beverage aisle and asking about). To complete the task, participants must follow several rules: "*you are not allowed to enter any aisle unless it is a part of a task, you are not allowed to go into the same aisle more than once, you are not allowed to buy more than two items for item category*". The time is stopped when the participant says: "*I finished*". After the tasks and the rules have been explained, patients are able to plan and choose the sequence of actions needed to complete the tasks. In this way, many different executive functions are stimulated: ability to plan a sequence of actions, problem solving and cognitive and behavioral flexibility.

Based on this, the virtual version of the Multiple Errands Test (VMET) has been recently developed and tested in different clinical populations [9, 10, 11].

Methods

Participants

We evaluated 30 OCD patients (M=15, F=15; mean age=33,07 years, std.dev.= 9,906) and 30 healthy controls (M=16, F=14; mean age=34,00 years, std.dev.=10,841) with no history of psychiatric disorder. Patients, selected from the Outpatient Unit of Psychiatry of Palermo University Hospital, were excluded from the study if they had a severe cognitive impairment (MMSE<19), a severe motor impairment which did not allow subjects to perform the procedure, auditory language comprehension difficulties (Token Test<26,5), object recognition impairments (Street Completion Test<2,25), excessive state and trait anxiety (STAI>40) and excessive depression state (Beck Depression Inventory>16).

Instrument and procedure

Decision making and cognitive behavioral flexibility were assessed by a 1) validated classic neuropsychological battery and by 2) Virtual Multiple Errands Test (V-MET), with uncertain goal, lacking information and undefined parameters.

The neuropsychological battery including: Trail Making Test (TMT, Forms A, B and B-A) to assess selective attention and task switching; Frontal Assessment Battery (FAB) to assess executive functions including ability to initiate and stop actions, to monitor and change behavior as needed, and to plan future behavior when faced with novel tasks and situations. Executive functions allow to anticipate outcomes and adapt to changing situations. Furthermore, to evaluate multi-tasking and cognitive flexibility, Phonological verbal fluency and Semantic verbal fluency were employed. Second assessment stimulates many different executive functions such as planning a sequence of actions, problem solving and cognitive and behavioral flexibility.

Results and conclusions

One-way analyses of variance (AnOVAs) were used to compare patients and controls performance.
Results showed a statistical significant difference between two groups. Both evaluation revealed a significantly poorer performance of OCD patients.
Regarding the neuropsychological evaluation, OCD patients show deficits in the attention function TMT A (F= 10,806, p= .002) and in task switching TMT A-B (F= 6,004, p= .018); difficulties in executive function, FAB (F= 13,857, p= .001) and in mental flexibility, Phonemic Fluencies (F= 11,212, p= .002), Semantic Fluencies (F= 18,288, p= .000).
In order to investigate differences in VMET, analyzed variables were the execution time for the entire task; the errors in executing the tasks; partial tasks failures, inefficiencies. Specific items of task failures regarding divided attention, self-correction, and no evidence of perseveration. After virtual reality assessment the clinical sample show a performance significantly lower (table 1).
First of all, in regard the time used by participant to complete the task, analysis showed significant differences between groups and indicated that the healthy control group took significantly less time compared with OCD patients (F=4,069, p= 0,040). Indeed the execution time for the whole task was higher in patients with OCD compared to controls, suggesting that patients with OCD need more time in planning than controls.
Concerning the task failure, results showed significant differences between groups, too. Patients showed errors in tasks requiring a change in the primary goal and the ability to respond simultaneously to multiple task demands (sub-tests 6, buying two products from the refrigerated products aisle), (sub-tests 7, going to the beverage aisle and asking about what to buy). Regarding inefficiencies (less capacity of planning) and errors of perseveration (persevering in errors is a clear sign of reduced flexibility) data revealed significant differences between groups. Patients showed poorer ability in using effective strategies that facilitate the carrying out of the tasks; for example, accurate planning before starting a specific subtask or using the map to move into the virtual supermarket. These executive deficits may reflect a specific deficit in cognitive flexibility; namely, ability to change selectively to effectively respond to external/internal stimulation. More, scores for divided attention are lower in controls (lower is the score, better is the performance).
On the basis of these results OCD patients showed difficulties in mental flexibility and in the task requiring divided attention. Consequently, patients are not able to recognize their own errors and autocorrect (reduced cognitive flexibility typical in OCD patients), modifying their behavior and their strategies based on the goal to reach. In conclusion,

Table 1. Virtual reality assessment

	OCD patients	Healthy control	
	Mean ± SD	*Mean ± SD*	*ANOVAs*
Time	10,77 ± 5,345	8,230 ± 4,284	F= 4,069, p= 0,040*
Sub test 6 *Buy two products from the refrigerated products*	9,66 ± 1,951	8,27 ± ,691	F= 13,457, p= 0,001†
Sub test 7 *Go to the beverage aisle and ask what to buy*	10,52 ± 2,181	8,77 ± 1,431	F= 13,373, p= 0,001†
Inefficiencies range: 8 (great ineff.) to 32 (no ineff.)	22,55 ± 4,733	25,57 ± 4,415	F= 6,407, p= 0,014*
Divided attention range: 7 (no errors) to 14 (great errors)	10,448 ± 2,667	8,333 ± 1,647	F= 13,531, p= 0,001†
Self-correction range: 7 (no errors) to 14 (great errors)	9,241 ± 1,902	7,833 ± ,833	F= 13,718, p= 0,000†
No perseveration range: 7 (no errors) to 14 (great errors)	8,724 ± 1,830	7,733 ± ,944	F= 6,896, p= 0,011*

†. Correlation is significant at the 0.01 level (2-tailed).*. Correlation is significant at the 0.05 level (2-tailed)

our results showed that VMET appears sensitive to evaluate the functional status of OCD with normal cognition, as manifested in terms of executive deficits. In particular, VMET allows the possibility to evaluate some subcomponents of executive functions in ecological settings, giving an accurate analysis of patients' deficits as well as traditional tests. Our data, confirming previous study, provide support for the feasibility of using the Virtual Multiple Errands Test (VMET) as an assessment tool of executive functions.

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